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Columbia River Channel Improvement—Dungeness Crab Research

Portland District is in the process of selecting new ocean disposal sites for disposal of dredge material from the federal navigation channel at the Mouth of the Columbia River (MCR). New sites are needed because the existing sites are either full or almost full, and are creating navigational hazards as well as environmental concerns. To gather as much information and input as possible in selecting the sites, a series of workshops was held with Federal and State resource agencies and interested private organizations to gather information and to help select potential sites.

During the course of the site designation workshops the participants decided they needed information on the impacts of dredged material disposal on Dungeness crab to select and evaluate potential sites. Concerns were expressed that crabs would be injured or killed during disposal operations, or would be buried and unable to dig out following disposal. Participants were particularly concerned with crabs in their soft shell state following molting, but also were concerned with impacts to hard shell crabs.

The only research that had been done on this subject was performed by Chang and Levings (1978). In that study, they placed 12 to 29 centimeter (cm) Dungeness crab in buckets and dumped from 1milimeter (mm) to 20cm on them over a one-minute period. The results of their study indicated that the crabs could all recover from 10cm placed on them, but that only two recovered from 20 cm. The study report did not indicate whether any of the crabs tested were soft shelled.

To respond to the concern about impacts to soft shell crabs, a series of tests was conducted at two research facilities: Scripps Institution of Oceanography in La Jolla, Calif., and Battelle NW Laboratories in Sequim, Wash. Scripps had conducted research for the Corps on excluder devices for dredge dragheads, and facilities were readily available to conduct disposal tests on crabs. The Battelle Laboratory in Sequim has had considerable experience in research on Dungeness crab, and also was qualified to conduct the research.

Dungeness crabs are readily available in Sequim Bay, off the Battelle dock. The crabs are not abundant in the ocean off Scripps. Consequently, crabs were provided by a fisherman from Humboldt Bay in northern California. The molting season in Humboldt Bay was over by the time the tests were conducted, so the Scripps tests were done with hard-shelled crabs. The crabs collected in Sequin Bay were mostly in a pre-molt condition and began to molt soon after being collected. Anywhere from one to several molted every day, allowing the tests to proceed at a fairly consistent rate.

Three disposal scenarios using three different size groups of crabs (<50mm, 50-100mm, and 100mm) were tested at Sequim. The disposal events simulate a shallow water disposal (about 60 feet), two moderately deep water disposals (about 100 and 140 feet) and a deep water

disposal (about 200 feet). The depth of material and duration of accumulation decreased with depth. The shallow water disposal accumulated 10.2 inches of sand in about 20 seconds. The first moderately deep disposal accumulated 6.6 inches in about 30 seconds, and the second moderately deep disposal accumulated 4.2 inches in about 90 seconds. The deep water disposal accumulated 2.4 inches in 120 seconds. The Scripps tests were done using crabs measuring from 4 inches to 6 inches for a shallow water disposal event.

For each test at each facility, the crabs were released into the tank and allowed to burrow into the sediment. After the crabs had burrowed in, the device developed to simulate a disposal operation was placed on top of the tank. The device was a large wooden box with slats on the bottom that could be partially opened to simulate the rate of disposal to be tested. Dry sand was used since wet sand tended to clump and did not fall uniformly, making simulating the duration of a disposal event difficult. Though dredged material is wet, tests done with wet and dry sand did not show any difference in crab reaction or sediment distribution. Since it was impossible to get wet sand to fall in the shorter durations that we wanted to evaluate it was decided to use dry sand in the tests. After the disposal was completed, the water in the tank was too turbid to see the exact number of crabs that had survived disposal. Observations were, however, made on the number of crabs that could be seen. The water column had cleared sufficiently in an hour for all the crabs to be counted. After the crabs were counted, the water was drawn down and the ones on the surface were removed and returned to the holding tanks. The disposal tank was checked hourly following the removal of the crabs to see if any had emerged from the sand. Crabs in the holding tanks were also checked hourly to see if they were still alive and were feeding.

Results of the tests at both facilities indicated most crabs came out of the sand and remained on the surface after disposal, and survived the disposal. Crabs that remained buried in the sand during disposal usually did not dig out after disposal. Occasionally some would dig out up to 24 hours after the test day. Crabs that remained buried in the sand usually died with in 24 to 48 hours, probably from suffocation, because none of the crabs that remained buried showed any signs of physical damage or of sand in the gills. All the crabs that were returned to the holding tank survived for several weeks following the test, indicating that no delayed mortality is occurring.

Chang, B.D. and C.D. Levings, 1978. Effects of burial on the heart cockle *Clinocardium nuttallii* and the Dungeness crab *Cancer magister*. Estuarine and Coastal Marine Science 7, 409-412.